

Influences of exercises in different postures on skin temperature of the body regions

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Introduction

One of the direct physiological responses to exercise is change in skin temperature. In other words, as the method in identifying the extent of thermoregulation by the physiological conditions between the human body and its environment, it is critical to observe skin temperature. Moreover, skin temperature is important in making proper estimates of the thermal insulation of clothing as the immediate environment to the human body. Thermal exchange by convection current and conduction between the human body and the external environment is proportional to the difference between the external temperature and skin temperature. Skin temperature demonstrates a high correlation with the subjective thermal comfort of the human body, and is highly significant as the thermal stress index of the thermal environment, including clothing and the core temperature. People move and live daily with clothing, and assume a variety of postures. It is important to observe the effects of posture on physiological responses as the basis in designing diverse work clothes, sportswear, and beddings. Thus, this study aims to examine the distribution of skin temperature according to the regions of the bare body to establish a basic database prior to researches on physiological responses with clothing. To this end, this study will focus on postures as the key factors in achieving more comfortable and functional clothing designs.

Method

The subjects were 10 healthy female adults with general physical figures. During the test, the women wore underwear. The temperatures and relative humidity for the preliminary test chamber and the main test chamber were 26 °C, 60 %, and 30 °C, 50 %, respectively. The postures in the exercise included lying and sitting positions. The type of exercise used was a leg exercise with an ergometer, in which the height of the saddle could be adjusted. The quantity of motion was 50% VO₂Max calculated under each exercise condition. The subjects took off their clothes in the preliminary test chamber, and put on brassieres and underpants. Then, they rested in a sitting position for 10 minutes. Next, they entered the test chamber, and rested at the given test postures (lying or sitting) for 40 minutes. The test was conducted through 15 minutes of exercise and a recovery period of 15 minutes. Data were

measured for 30 minutes during the exercise and the recovery periods. The test was randomly carried out it was performed twice or thrice per subject under each test condition. The results were based on the average values taken from the tests. Skin temperature according to the region of the body was measured, and the average skin temperature was determined through the measured skin temperature values. The measuring instrument used was the thermistor thermometer. To measure skin temperature, thermistor sensors were attached to two regions on the face, two regions on the nape, chest, and back, and 13 regions on the belly, upper arm, forearm, back of the hand, lower leg, and on top of the foot by using a flexible adhesive tape. Skin temperature was measured and calculated every minute on the computer. The average skin temperature was calculated in accordance with the reference to the 13-point method of Tamura.

Results and Considerations

According to the skin temperature by body region, all body regions showed distinct differences in skin temperature, depending on the exercise posture ($p < 0.01$ on the forehead, and $p < 0.05$ on other regions). For the trout regions with broad surface areas, the skin temperature at the lying position was higher than that in the sitting position. At the limbs, the skin temperature at the lying position was lower than that at the sitting position. The skin temperature by body region was generally highest on the face, followed by the trout and the limbs. The average skin temperature also showed the difference in exercise postures ($p < 0.01$), which was higher at the lying position during the overall process at the beginning of the exercise to the recovery phase after exercise. The average skin temperature at the lying position was 34.1°C during the exercise and 34.3°C at the recovery phase, and during the sitting position at 33.8°C during the exercise and 34.1°C at the recovery phase. The average skin temperature fell at the initial stage of the exercise in both positions, but it continuously rose during the recovery phase after 15 minutes from the middle phase of the exercise.

According to the examination of the distribution of skin temperature by body region, depending on exercise postures, it was concluded that the skin temperature by body region changed depending on exercise postures. Moreover, it was identified that the skin temperatures at both lying and sitting positions under room temperatures of 30°C were 33°C or more. The comfortable temperature inside the clothing was set at 32°C . It was also noted that the average skin temperature on the surface of the body under the same condition was about 33°C . In conclusion, this test suggested greater importance be placed in examining body postures in specific activities to achieve both comfort and functionality in clothing, especially, when the importance of selecting patterns and materials would facilitate thermal radiation from the human body.

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